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NPG REPORT NO. 1193

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Fourteenth Partial Report
on
Development of a Cool Propellant
for the 5"/54 Caliber Gun

Final Report
on
Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968, and EX-6969

Project No.: NPG-Re2d-61-1-53
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Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968, and EX-6969

PART A

SYNOPSIS

1. This is the fourteenth partial report on Task Assignment NPG-Re2d-61-1-52, the "Development of a Cool Propellant for the 5"/54 Caliber Gun", and the final report on "Ballistic Test of Cool Propellants EX-6907, EX-6908, EX-6909, EX-6967, EX-6968, and EX-6969".

2. From the results of the subject test, it is concluded that for the 5"/54 caliber gun:

a. The ballistic uniformity of the subject propellants was satisfactory.

b. EX-6909 and EX-6967 met the ballistic specifications using the new gun method determination but were unsatisfactory using the matched powder method.

EX-6969 was ballistically satisfactory at a PPD (Production Packing Depth) of 0!3 (near full case capacity).

c. Varying amounts of carbon were obtained with EX-6907, EX-6908, and EX-6909. No carbon deposition was observed on EX-6967, EX-6968, or EX-6969.

d. The pressure-time curves obtained with EX-6907 had pronounced steps occurring in the pressure-rise region. EX-6908 and EX-6967 gave smoother curves and were similar to those obtained with IHBF-3. The smoothest curves were obtained with EX-6909, EX-6968, and EX-6969 and were comparable to those obtained with the picrite powder EX-6882.

Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968, and EX-6969
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Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968, and EX-6969

PART B

INTRODUCTION

1. AUTHORITY:

The tests reported herein were authorized by references (b) and (c) and conducted under Task Assignment NPG-Re2d-61-1-52, established by reference (a). Current work on the development of a cool propellant for the 5"/54 caliber gun is continuing under Task Assignment NPG-Re2d-61-1-53.

2. REFERENCES:

- a. BUORD Conf ltr Re2d-CNB:aph NP9 Ser 24046 of 6 Aug 1951
- b. BUORD Conf ltr Re2d-CNB:aph NP9 Ser 30681 of 18 Dec 1951
- c. BUORD Conf ltr Re2d-ERD:aph Ser 38723 of 3 May 1952
- d. NPG Conf Report No. 770 of 9 June 1951
- e. NPG Conf Report No. 1192 of 20 Nov 1953
- f. Description Sheets of Manufacture and Closed Bomb Data

3. BACKGROUND:

Reference (a) established the general task for the development of cool propellants for the 5"/54 caliber gun. References (b) and (c) requested the subject powders be ballistically evaluated in the 5"/54 caliber gun with the 70 lb. projectile at 2650 f/s velocity in the 17.0 - 18.5 tsi pressure range. Reference (b) described EX-6907, EX-6908, and EX-6909 as cool NH powders with nominal flame temperatures around 2200°K prepared as part of the program to improve barrel life under rapid fire conditions. Reference (c) described EX-6967, EX-6968, and EX-6969 as cool NH powders with nominal flame temperatures around 2275°K. These powders were manufactured after it was found that EX-6907, EX-6908, and EX-6909 gave varying amounts of carbon deposition.

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Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968, and EX-6969

4. OBJECT OF TEST:

a. To determine whether the subject propellants are ballistically suitable for the 5"/54 caliber gun.

b. To determine the extent, if any, of carbon deposition resulting from these propellants.

c. To obtain data relative to manufacture of a large lot of similar powder for continuation of erosion trials in the 5"/54 caliber gun.

5. PERIOD OF TEST:

a. Dates of Project Letters: 6 Aug 1951
18 Dec 1951

b. Dates Material Received:
EX-6907, 6908, 6909 13 Dec 1951
EX-6967, 6968, 6969 23 Apr 1952

c. Date Commenced Test 14 Jan 1952

d. Test Completed: 4 Aug 1953

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Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968, and EX-6969

PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEMS UNDER TEST:

Reference (f) gave in detail the powder description and closed bomb data. A summary of the data follows:

<u>Actual Composition</u>	<u>EX-6907</u>	<u>EX-6908</u>	<u>EX-6909</u>
Nitrocellulose (13.20%N)	82.90%	82.80%	82.50%
Dinitrotoluene	9.80	9.84	10.58
Dibutylphthalate	7.30	7.36	6.92
Diphenylamine (added)	1.20	1.23	1.21

	<u>EX-6967</u>	<u>EX-6968</u>	<u>EX-6969</u>
Nitrocellulose (13.20%N)	83.73%	84.17%	83.94%
Dinitrotoluene	11.09	11.20	12.18
Dibutylphthalate	5.18	4.63	3.88
Diphenylamine (added)	0.87	0.89	0.97
Lead Carbonate (added)	0.97	0.96	1.01

Reference (f) also gave the following information:

<u>Sample</u>	<u>Calc. Flame Temp. (K°)</u>	<u>Grain Dimensions</u>			<u>No. of Perfs.</u>	<u>RQ (%)</u>	<u>RF (%)</u>
		<u>Length (in)</u>	<u>Diam. (in)</u>	<u>Av. Web. (in)</u>			
EX-6907	2239	0.560	0.2164	0.0380	7	129.7(a) 124.1(b)	105.9(a) 93.6(b)
EX-6908	2148	0.649	0.2510	0.0459	7	96.3(a) 92.1(b)	102.7(a) 92.2(b)
EX-6909	2068	0.795	0.3175	0.0566	7	66.9(a) 63.7(b)	99.8(a) 88.9(b)
EX-6967	2329	0.8034	0.3285	0.0576	7	93.9(a) 95.3(b)	106.3(a) 94.2(b)
EX-6968	2372	1.0360	0.4018	0.0703	7	79.1(a) 78.5(b)	106.6(a) 93.7(b)
EX-6969	2362	1.0752	0.4533	0.0789	7	68.0(a) 63.3(b)	105.0(a) 92.3(b)

(a) Based on EX-6586 as 100% at 90°F

(b) Based on IHBF-3 as 100% at 90°F

Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968, and EX-6969

7. PROCEDURE:

The subject propellants were fired in the 5"/54 caliber gun for charge determination. Muzzle velocities, maximum pressures (copper crusher), ejection times, and visual observation of flash, smoke, and carbon deposition were recorded. All rounds were assembled at PPD (Production Packing Depth). Pressure-time records were obtained with each of the propellants.

8. RESULTS AND DISCUSSION:

The results of the subject test are given in detail in the appendices and are summarized below:

a. Uniformity

Date 1952	Powder	PPD (in)	Charge (lbs.)	Velocity (f/s)	Pressure (tsi)	Ejec. Time (sec)	No. of Rds.
1-14	IHBF-3	6.7	17.62	2654±3	20.0±0.3	0.018±0.001	5
"	EX-6907	13.2	13.00	2186±2	14.8±0.0	0.019±0.000	2
"	EX-6908	4.3	19.00	2670±2	20.8±0.1	0.018±0.001	4
1-15	EX-6908	4.3	19.00	2663±3	21.2±0.1	0.017±0.000	4
"	EX-6909	5.3	18.00	2267±2	11.5±0.1	0.020±0.001	2
"	"	0.0	21.50	2669±5	17.6±0.3	0.019±0.002	4
"	EX-6907	9.4	15.50	2481±2	27.8±1.2	0.019±0.002	2
9-5	IHBF-3	6.7	17.59	2589±11	16.0±0.3	--	5
"	EX-6967	13.1	13.00	1867±1	9.2(a)	--	2
"	"	3.8	19.40	2602±5	16.7±0.2	--	4
"	EX-6968	9.5	15.00	1860±1	6.7±0.0	--	2
"	"	0.4	21.00	2556±2	13.8±0.0	--	2
9-17	EX-6967	3.1	19.82	2619±9	16.1±0.8	0.020±0.002	2
"	EX-6909	0.0	21.33	2492±2	13.4±0.1	0.020±0.001	2
"	EX-6908	4.4	18.81	2560±3	17.1±0.2	0.021±0.001	2
"	EX-6907	10.7	15.00	2382±2	20.0±0.3	0.021±0.001	2

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Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968, and EX-6969

Date 1953	Powder	PPD (in)	Charge (lbs.)	Velocity (f/s)	Pressure (tsi)	Ejec. Time (sec.)	No. of Rds.
7-27	IHBF-3	6.6	17.59	2591±2	17.4±0.2	0.022±0.001	2
"	EX-6882	7.7	18.10	2560±6	15.5±0.2	0.023±0.001	2
"	EX-6907	10.7	15.00	2388±2	21.3±0.2	0.021±0.002	2
"	EX-6908	4.4	18.81	2566±3	16.8±0.3	0.019±0.000	2
"	EX-6909	0.0	21.33	2493±8	13.9±0.1	0.022±0.001	2
"	EX-6967	3.1	19.82	2640±1	17.4±0.6	0.019±0.001	2
"	EX-6968	0.3	21.00	2575±1	14.7±0.1	0.020±0.001	2
"	EX-6969	0.2	21.00	2322±6	11.4±0.0	0.022±0.001	2
4-8	IHBF-3	6.7	17.59	2665±2	20.3±0.2	--	5
"	EX-6909	5.3	18.00	2266±11	11.7±0.1	--	2
"	EX-6909	0.2	21.30	2625±6	16.7±0.2	--	5

b. Charge Determination:

Powder	Velocity (f/s)	Charge (lbs.)	PPD (in)	Pressure (tsi)	Results
EX-6907	2650	17.12(a)	7.3	--	Too fast
EX-6907	2650	17.15(b)	7.3	--	Too fast
EX-6908	2650	18.81(a)	4.9	20.5	Too fast
EX-6908	2650	18.85(b)	4.9	20.2	Too fast
EX-6909	2650	21.33(a)	1.3	17.2	(c)
EX-6909	2650	21.67(b)	0.8	16.4	Too slow
EX-6967	2650	19.79(a)	3.7	17.7	(c)
EX-6967	2650	19.29(b)	4.3	19.9	Too fast
EX-6968	2650	21.78(a)	-0.4	14.7	Too slow
EX-6968	2650	21.28(b)	+0.3	17.6	(d)
EX-6969	2650	24.11(a)	-4.0	12.3	Too slow
EX-6969	2650	23.57(b)	-3.1	15.5	Too slow

(a) New Gun Method

(b) Matched Powder Method

(c) Satisfactory by new gun method - unsatisfactory by matched powder method.

(d) Satisfactory at full case capacity.

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Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968, and EX-6969

c. The ballistic uniformity obtained with the subject propellants was satisfactory.

d. None of the subject propellants were suitable for the 5"/54 caliber gun except EX-6909 and EX-6967 which were satisfactory ballistically by the new gun method determination but unsatisfactory by the matched powder method, and EX-6968 which was satisfactory at full case capacity by the matched powder method.

e. Varying amounts of carbon were obtained with EX-6907, EX-6908 and EX-6909 (Flame temperatures 2068 to 2239°K). No carbon deposition was observed with EX-6967, EX-6968, or EX-6969 (flame temperatures 2329 to 2372°K).

f. The pressure-time curves obtained with EX-6907 had pronounced steps occurring in the pressure-rise region. EX-6908 and EX-6967 gave smoother curves with less pronounced steps in the pressure-rise region and were similar to those obtained with the master powder IHB-3. The smoothest curves were obtained with EX-6909, EX-6968 and EX-6969 and were comparable to those obtained with the picrite powder EX-6882.

PART D

CONCLUSIONS

9. From the results of the subject test it is concluded that for the 5"/54 caliber gun,

a. The ballistic uniformity of the subject propellants was satisfactory.

b. EX-6909 and EX-6967 met the ballistic specifications using the new gun method determination but were unsatisfactory using the matched powder method.

EX-6969 was ballistically satisfactory at a PPD (Production Packing Depth) of 0.3 (near full case capacity).

c. Varying amounts of carbon were obtained with EX-6907, EX-6908 and EX-6909. No carbon deposition was observed on EX-6967, EX-6968, or EX-6969.

d. The pressure-time curves obtained with EX-6907 had pronounced steps occurring in the pressure-rise region. EX-6908 and EX-6967 gave smoother curves and were similar to those obtained with IHB-3. The smoothest curves were obtained with EX-6909, EX-6968, and EX-6969 and were comparable to those obtained with the picrite powder EX-6882.

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Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968, and EX-6969

The tests upon which this report is based were conducted by:

J. A. KRYSTOFIK, Head of Test Branch
Interior Ballistics Division
Armament Department


This report was prepared by:

J. A. KRYSTOFIK, Head of Test Branch
Interior Ballistics Division
Armament Department

This report was reviewed by:

D. C. CAIN, Head of Interior Ballistics Division
Armament Department
L. C. KLINGAMAN, Commander, USN
Armament Officer
Armament Department
C. C. BRAMBLE, Director of Research, Ordnance Group

APPROVED: J. F. BYRNE
Captain, USN
Commander, Naval Proving Ground



E. A. RUCKNER
Captain, USN
Ordnance Officer
By direction

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EX-6909, EX-6967, EX-6968, and EX-6969

TABULATION OF FIRING DATA

Gun: 5"/54 Caliber
Mk 18-0, No. 16075, ESR = 19.78
D₀ = Not Available
Type G-0, No. 16070, ESR = 1187.4 D₀ = 5"148

Projectile: Mk 41-0 (70 lb.) Epsom Salts Loaded.

Cartridge Case: Mk 7-0

Primer: XC-M5B and Mk 45 (as indicated).

Plug: Cork, Mk 6 on low charge rounds. Plastic on remainder.

Wad and Spacer: Cardboard, NGF Dwg. 132664 Pc. Nos. 15 and 18 (as required).

Lead Foil: 135 grams per round.

Powder Temp: 90°F

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Ballistic Test of Cool Propellants EX-6907, EX-6908, EX-6909, EX-6967, EX-6968, and EX-6969

TABULATION OF FIRING DATA (Continued)

Date: 14 January 1952

Gun No.: 16075

Rd. No.	Powder	Primer	PPD (in.)	Charge (lbs.)	Velocity (f/s)	Pressure (t.s.i.)	Ejec. Time (sec.)	Flash (%)	Smoke (%)
1(a)	IHBF-3	XC-M5B	6.7	17.62	2637	19.2	.021	0	150
2	"	"	"	"	2652	20.4	.018	100	"
3	"	"	"	"	2657	20.0	.018	0	"
4	"	"	"	"	2649	19.5	.017	100	"
5	"	"	"	"	2660	20.3	.017	0	"
6	"	"	"	"	2653	19.8	.020	0	"
Mean of 5 rounds					2654±3	20.0±0.3	0.018±0.001		
7(a)	EX-6907	XC-M5B	14.8	12.00	2068	13.1	.020	0	150
8	"	"	13.2	13.00	2184	14.8	.019	"	"
9	"	"	"	"	2187	14.8	.019	"	"
Mean of 2 rounds					2186±2	14.8±0.0	0.019±0.000		
10	EX-6907	XC-M5B	9.4	15.50	2453	22.9	.017	0	150
11	"	"	8.7	16.00	2524	27.5	.016	"	"
12	EX-6908	"	10.2	15.00	2239	12.8	.020	"	"
13	"	"	"	"	2240	12.6	.019	"	"
Mean of 2 rounds					2240±1	12.7±0.1	0.020±0.001		
14	EX-6908	XC-M5B	5.8	18.00	2553	18.6	.017	0	150
15	"	"	4.3	19.00	2671	21.0	.020	"	"
16	"	"	"	"	2666	20.6	.017	"	"
17	"	"	"	"	2670	20.8	.018	"	"
18	"	"	"	"	2671	20.7	.018	"	"
Mean of 4 rounds					2670±2	20.8±0.1	0.018±0.001		
19	EX-6908	XC-M5B	3.6	19.5	2729	22.2	.016	0	150

(a) Conditioning round - omitted

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Ballistic Test of Cool Propellants EX-69C7, EX-6908, EX-69C9, EX-6967, EX-6968, and EX-6969

TABULATION OF FIRING DATA (Continued)

Date: 15 January 1953

Gun No.: 16075

Rd. No.	Powder	Primer	PPD (in.)	Charge (lbs.)	Velocity (f/s)	Pressure (t.s.i.)	Ejec. Time (sec.)	Flash (%)	Smoke (%)
1(a)	EX-6908	XC-M5B	4.3	19.00	2646	21.5	.018	-	-
2	"	"	"	"	2665	21.4	.017	-	-
3	"	"	"	"	2664	21.1	.017	-	-
4	"	"	"	"	2656	21.2	.016	-	-
5	"	"	"	"	2666	21.0	.017	-	-
Mean of 4 rounds					2663±3	21.2±0.1	.017±0.000	-	-
6	EX-6909	XC-M5B	5.3	18.00	2269	11.4	.019	-	-
7	"	"	"	"	2265	11.5	.021	-	-
Mean of 2 rounds					2267±2	11.5±0.1	.020±0.001	-	-
8	EX-6909	XC-M5B	0.5	21.00	2615	17.0	.018	-	-
9	"	"	0.0	21.50	2663	17.0	.021	-	-
10	"	"	"	"	2675	17.9	.018	-	-
11	"	"	"	"	2674	17.8	.017	-	-
12	"	"	"	"	2665	17.6	.018	-	-
Mean of 4 rounds					2669±5	17.6±0.3	.019±0.002	-	-
13	EX-6909	XC-M5B	-0.8	22.00	2725	19.3	.017	-	-
14	EX-69C7	"	9.4	15.50	2482	26.6	.017	-	-
15	"	"	"	"	2479	29.0	.020	-	-
Mean of 2 rounds					2481±2	27.8±1.2	.019±0.002	-	-
16	EX-69C7	XC-M5B	0	21.50	2654	17.6	.020	-	-

(a) Conditioning round - omitted

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Ballistic Test of Cool Propellants EX-69C7, EX-69C8, EX-6909, EX-6967, EX-6968, and EX-6969

TABULATION OF FIRING DATA (Continued)

Date: 5 September 1952

Gun No.: 16070

Rd. No.	Powder	Primer	PPD (in.)	Charge (lbs.)	Velocity (f/s)	Pressure (t.s.i.)	Carbon (%)	Flash (%)	Smoke (%)
1(a)	IHBF-3	Mk-45	6.7	17.59	2599	16.3	C	50	125
2	"	"	"	"	2561	15.9	"	100	100
3	"	"	"	"	2591	15.6	"	"	"
4	"	"	"	"	2605	15.8	"	"	"
5	"	"	"	"	2591	16.0	"	"	"
6	"	"	"	"	2595	16.7	"	"	"
Mean of 5 rounds					2589±11	16.0±0.3			
7(a)	EX-6967	Mk-45	14.5	12.00	1740	9.2	O	100	100
8	"	"	13.1	13.00	1866	9.2	"	"	"
9	"	"	"	"	1867	-	"	100	125
Mean of 2 rounds					1867±1(b)	9.2			
10	EX-6967	Mk-45	8.7	16.00	2227	10.6	O	100	125
11	"	"	5.8	18.00	2450	13.4	O	100	125
12	"	"	4.4	19.00	2552	15.5	O	100*	125
13	"	"	3.8	19.40	2596	16.6	O	0	125
14	"	"	"	"	2598	16.3	O	100	100
15	"	"	"	"	2604	17.1	O	100	100
16	"	"	"	"	2610	16.7	O	100	100
Mean of 4 rounds					2602±5	16.7±0.2			
17	EX-6967	Mk-45	3.1	19.90	2666	18.1	O	100	100
18	EX-6968	"	9.5	15.00	1860	6.7	"	"	"
19	"	"	"	"	1860	6.7	"	"	"
20	"	"	"	"	1859	6.7	"	"	"
Mean of 2 rounds					1860±1	6.7±0.0			

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Ballistic Test of Cool Propellants EX-69C7, EX-6908, EX-69C9, EX-6967, EX-6968, and EX-6969

TABULATION OF FIRING DATA (Continued)

Date: 5 September 1952 (Continued)

Gun No.: 16070

Rd. No.	Powder	Primer	PPD (in.)	Charge (lbs.)	Velocity (f/s)	Pressure (t.s.i.)	Carbon (%)	Flash (%)	Smoke (%)
21	EX-6968	Mk-45	7.2	16.50	2021	9.0	0	100	100
22	"	"	3.4	19.00	2334	11.1	"	"	"
23	"	"	0.4	21.00	2557	13.8	"	"	"
24	"	"	"	"	2554	13.8	"	"	"
	Mean of 2 rounds			21.00	2556±2	13.8±0.0			
25	EX-6969	Mk-45	7.9	16.00	1784	9.2	0	100	100
26	"	"	4.9	18.00	1985	-	"	"	"
27	"	"	0.3	21.00	2316	11.1	"	"	"

*Flashback

- (a) Conditioning round - omitted
- (b) Based on 1 round

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Ballistic Test of Cool Propellants EX-6907, EX-6908, EX-6909, EX-6967, EX-6968, and EX-6969

TABULATION OF FIRING DATA (Continued)

Date: 27 July 1953

Rd. No.	Powder	PPD (in.)	Charge (lbs.)	Velocity (f/s)	Pressure (t.s.i.)	Ejec. Time (sec.)	Flash (%)	Smoke (%)	Carbon (%)(b)
1 (a)	IHBF-3	6.7	17.59	2575	17.1	0.018	75	100	0
2	"	6.6	"	2592	17.2	0.021	100	"	"
3	"	"	"	2589	17.6	0.022	"	"	"
	Mean of 2 rounds		17.59	2591±2	17.4±0.2	0.022±0.001			
4	EX-6882	7.7	18.10	2554	15.3	0.023	75	100	0
5	"	"	"	2566	15.7	0.022	"	"	"
	Mean of 2 rounds		18.10	2560±5	15.5±0.2	0.023±0.001			
6	EX-6907	10.7	15.00	2386	21.1	0.019	0	150(c)	25
7	"	"	"	2389	21.5	0.022	"	"	"
	Mean of 2 rounds		15.00	2388±2	21.3±0.2	0.021±0.002			
8	EX-6908	4.4	18.81	2563	16.5	0.019	50	125	15
9	"	"	"	2568	17.0	0.019	"	"	"
	Mean of 2 rounds		18.81	2566±3	16.8±0.3	0.019±0.000			
10	EX-6909	0.0	21.33	2485	13.8	0.021	100	100	10
11	"	"	"	2500	14.0	0.022	"	"	"
	Mean of 2 rounds		21.33	2493±8	13.9±0.1	0.022±0.001			
12	EX-6967	3.1	19.82	2639	16.8	0.018	100	100	0
13	"	"	"	2640	17.9	0.019	"	"	"
	Mean of 2 rounds		19.82	2640±1	17.4±0.6	0.019±0.001			
14	EX-6968	0.3	21.00	2575	14.6	0.020	100	100	0
15	"	"	"	2574	14.7	0.019	"	"	"
	Mean of 2 rounds		21.00	2575±1	14.7±0.1	0.020±0.001			
16	EX-6969	0.2	21.00	2327	11.4	0.021	100	100	100
17	"	"	"	2316	11.4	0.021	"	"	"
	Mean of 2 rounds		21.00	2322±6	11.4±0.0	0.022±0.001			

(a) Conditioning round - omitted

(b) Based on EX-6735 as 100% (ref. (d)).

(c) Black Smoke

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Ballistic Test of Cool Propellants EX-6907, EX-6908, EX-6909, EX-6967, EX-6968, and EX-6969

TABULATION OF FIRING DATA (Continued)

Date: 17 September 1952

Gun No.: 16070

Rd. No.	Powder	Primer	PPD (in.)	Charge (lbs.)	Velocity (f/s)	Pressure (t.s.i.)	Ejec. Time (sec.)	Flash (%)	Smoke (%)
1	IHBF-3	Mk-45	6.7	17.59	2599	17.5	0.020	0	150
2	EX-6969	"	0.2	21.00	2323	11.0	0.024	100	100
3	EX-6968	"	0.3	21.00	2549	13.6	0.019	"	"
4	EX-6967	"	3.1	19.82	2628	16.9	0.021	"	"
5	"	"	"	"	2610	15.3	0.018	"	"
	Mean of 2 rounds		3.1	19.82	2619±9	16.1±0.8	0.020±0.002		
6	EX-6909	Mk-45	0.0	21.33	2490	13.3	0.020	100	100
7	"	"	"	"	2494	13.5	0.019	100	100
	Mean of 2 rounds		0.0	21.33	2492±2	13.4±0.1	0.020±0.001		
8	EX-6908	Mk-45	4.4	18.81	2562	17.3	0.020	0	150
9	"	"	"	"	2557	16.9	0.021	"	"
	Mean of 2 rounds		4.4	18.81	2560±3	17.1±0.2	0.021±0.001		
10	EX-6907	Mk-45	10.7	15.00	2380	19.7	0.021	0	150
11	"	"	"	"	2384	20.3	0.020	"	"
	Mean of 2 rounds		10.7	15.00	2382±2	20.0±0.3	0.021±0.001		

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Ballistic Test of Cool Propellants EX-6907, EX-6908, EX-6909, EX-6967, EX-6968, and EX-6969

TABULATION OF FIRING DATA (Continued)

Date: 8 April 1953

Gun No.: 16077

<u>Rd. No.</u>	<u>Powder</u>	<u>PPD (in.)</u>	<u>Charge (lbs.)</u>	<u>Velocity (f/s)</u>	<u>Pressure (t.s.i.)</u>	<u>Flash (%)</u>	<u>Smoke (%)</u>
1 - 10	Reported Separately.	6.7	17.59	2663	20.0	75	100
11 (a)	IHBF-3	"	"	2661	20.2	100	"
12	"	"	"	2665	20.2	0	150
13	"	"	"	2666	20.0	75	100
14	"	"	"	2665	20.3	0	150
15	"	"	"	2669	20.9	75	100
16	"	"	17.59	2665±2	20.3±0.2		
Mean of 5 rounds							
17 - 26	Reported Separately.						
27 (a)	EX-6908	4.3	19.00	2662	20.6	0	150
28	EX-6909	5.3	18.00	2277	11.8	100	100
29	"	"	"	2255	11.6	"	"
Mean of 2 rounds				2266±11	11.7±0.1		
30	EX-6909	0.2	21.30	2624	16.9	100	100
31	"	"	"	2639	17.0	"	"
32	"	"	"	2616	16.3	"	"
33	"	"	"	2625	16.5	"	"
34	"	"	"	2621	16.6	"	"
Mean of 5 rounds				2625±6	16.7±0.2		
35	EX-6909	0.0	21.50	2632	16.6	100	100

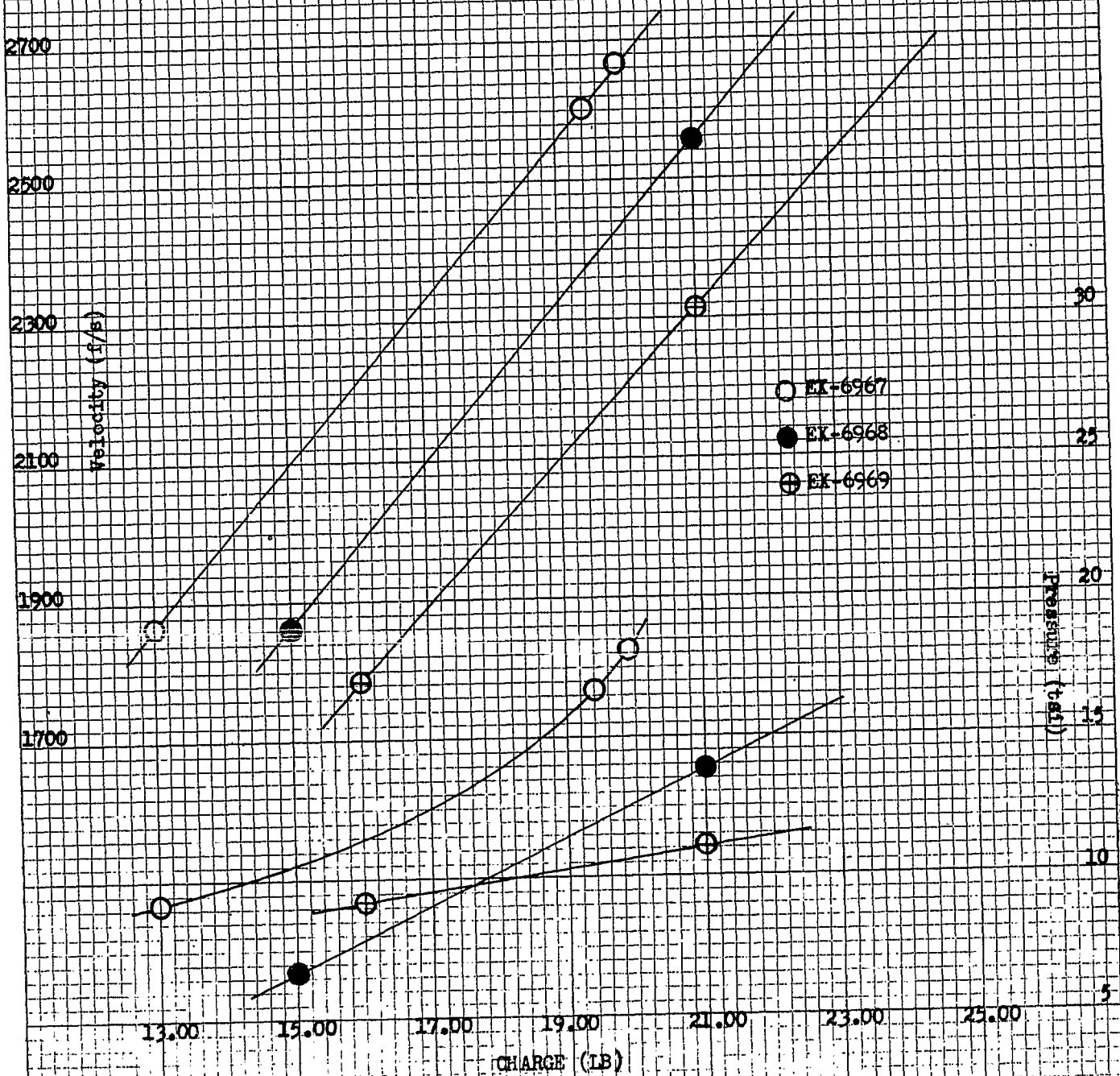
(a) Conditioning round - omitted

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BALLISTIC TEST OF COOL PROPELLANTS

Velocity and Pressure vs Charge

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APPENDIX B

Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968 and EX-6969

PRESSURE-TIME RECORDS

DATE: 7/27/53
Rd. No. 2

Velocity: 2592 f/s
Pressure: 17.2 t.s.i.

1HBF-3
17.59 lb.

CALIBRATION

52600
P.s.i.

0.001 Sec.

DATE: 7/27/53
Rd. No. 3

Velocity: 2589 f/s
Pressure: 17.6 t.s.i.

1HBF-3
17.59 lb.

CALIBRATION

51300
P.s.i.

0.001 Sec.

DATE: 7/27/53
Rd. No. 4

Velocity: 2554 f/s
Pressure: 15.3 t.s.i.

EX-6882
18.10 lb.

CALIBRATION

51400
P.s.i.

0.001 Sec.

DATE: 7/27/53
Rd. No. 5

Velocity: 2566 f/s
Pressure: 15.7 t.s.i.

EX-6882
18.10 lb.

CALIBRATION

50300
P.s.i.

0.001 Sec.

DATE: 7/27/53
Rd. No. 6

Velocity: 2386 f/s
Pressure: 21.1 t.s.i.

EX-6907
15.00 lb.

CALIBRATION

51400
P.s.i.

0.001 Sec.

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Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968 and EX-6969

PRESSURE-TIME RECORDS

DATE: 7/27/53
Rd. No. 7

Velocity: 2389 f/s
Pressure: 21.5 t.s.i.

EX-6907
15.00 lb.

CALIBRATION

51700
P.S.I.

0.001 Sec.

DATE: 7/27/53
Rd. No. 8

Velocity: 2563 f/s
Pressure: 16.5 t.s.i.

EX-6908
18.81 lb.

CALIBRATION

52600
P.S.I.

0.001 Sec.

DATE: 7/27/53
Rd. No. 9

Velocity: 2568 f/s
Pressure: 17.0 t.s.i.

EX-6908
18.81 lb.

CALIBRATION

55400
P.S.I.

0.001 Sec.

DATE: 7/27/53
Rd. No. 10

Velocity: 2485 f/s
Pressure: 13.8 t.s.i.

EX-6909
21.33 lb

CALIBRATION

52600
P.S.I.

0.001 Sec.

DATE: 7/27/53
Rd. No. 12

Velocity: 2639 f/s
Pressure: 16.8 t.s.i.

EX-6967
19.82 lb

CALIBRATION

52000
P.S.I.

0.001 Sec.

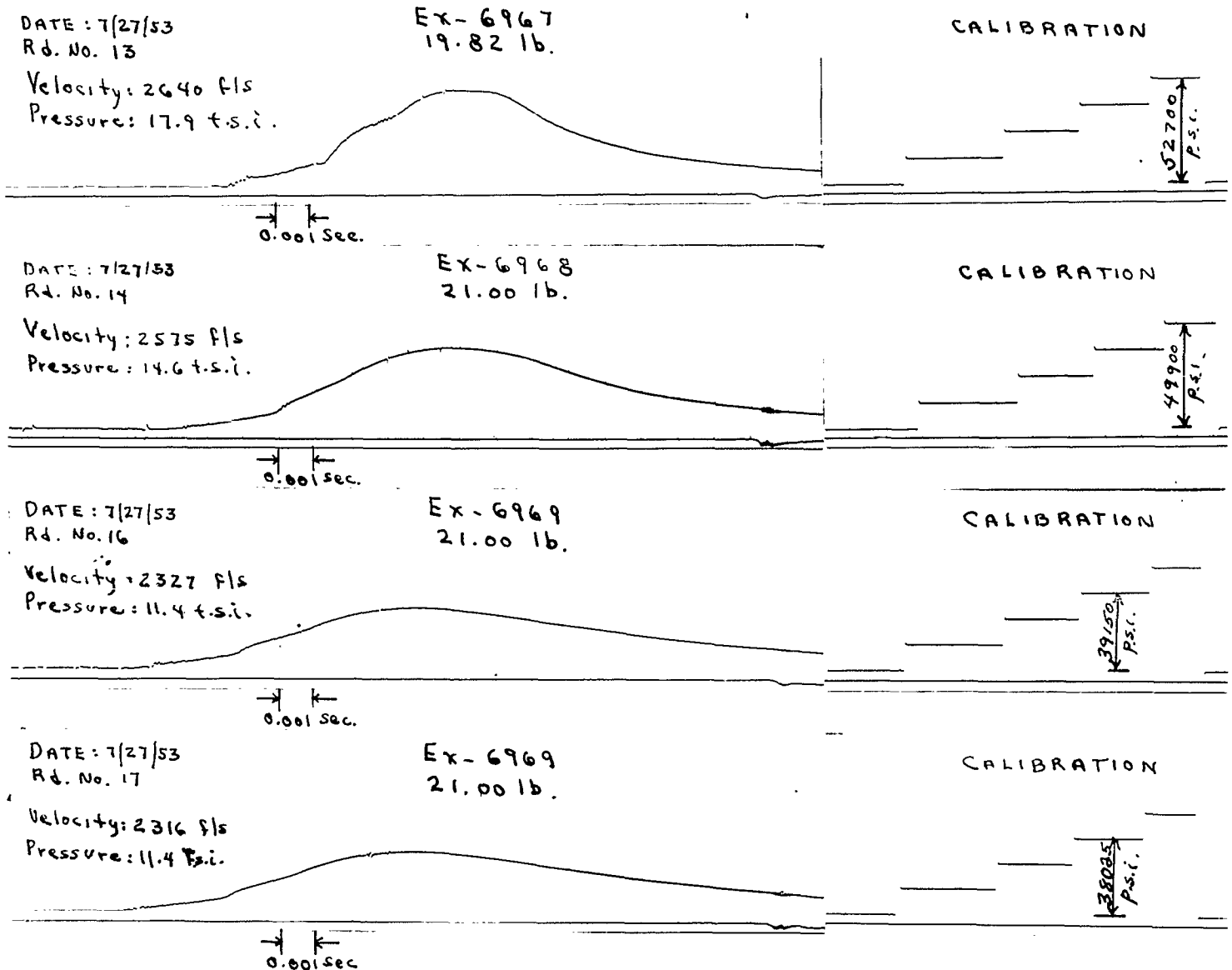
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Ballistic Test of Cool Propellants EX-6907, EX-6908,
EX-6909, EX-6967, EX-6968 and EX-6969

PRESSURE-TIME RECORDS



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